M/021/004

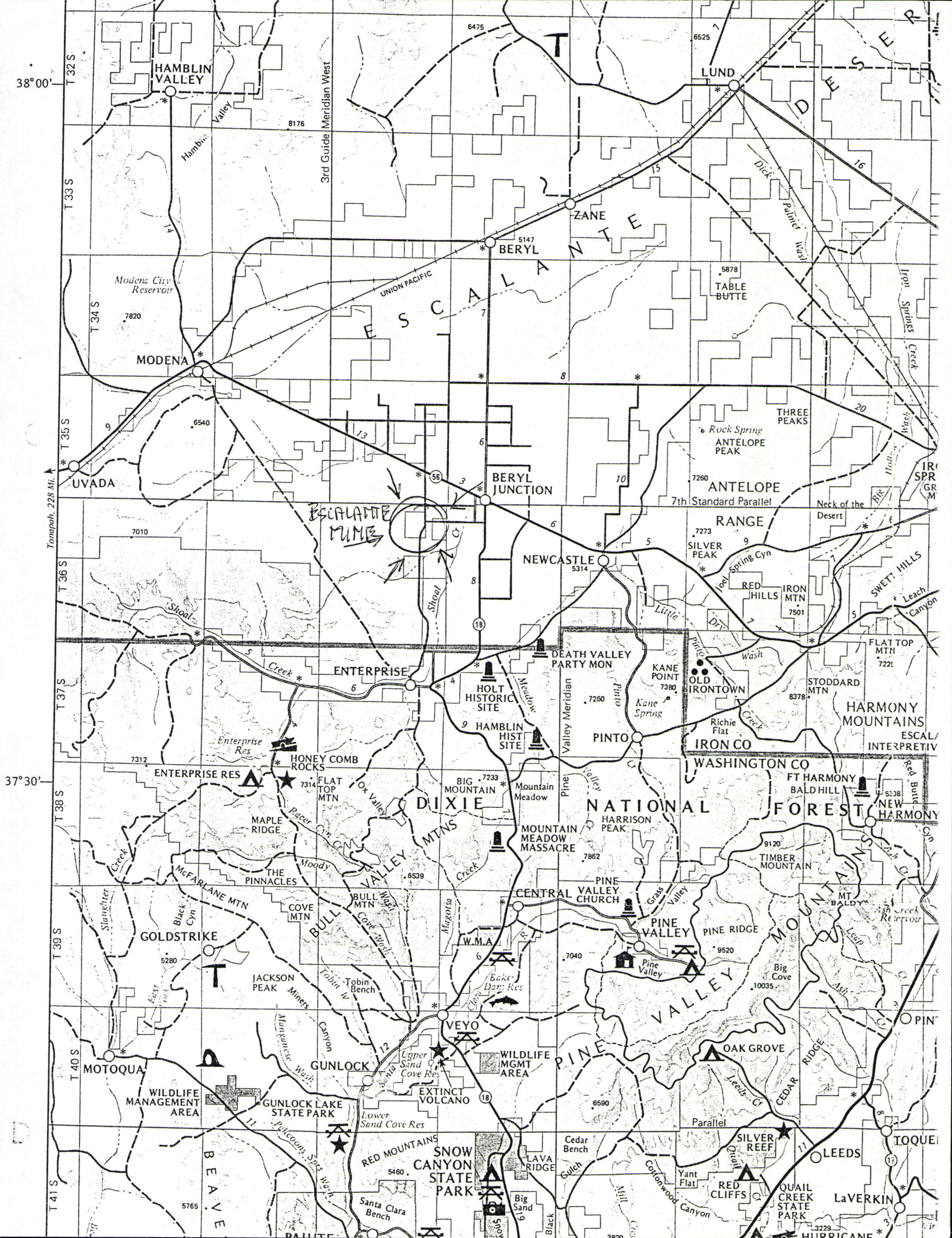
ESCALANTE SILVER MINE

HECLA MINING COMPANY

Brief
for

Division of Oil, Gas and Mining

1991 SPRING JAMBOREE



38°00'
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T 39 S
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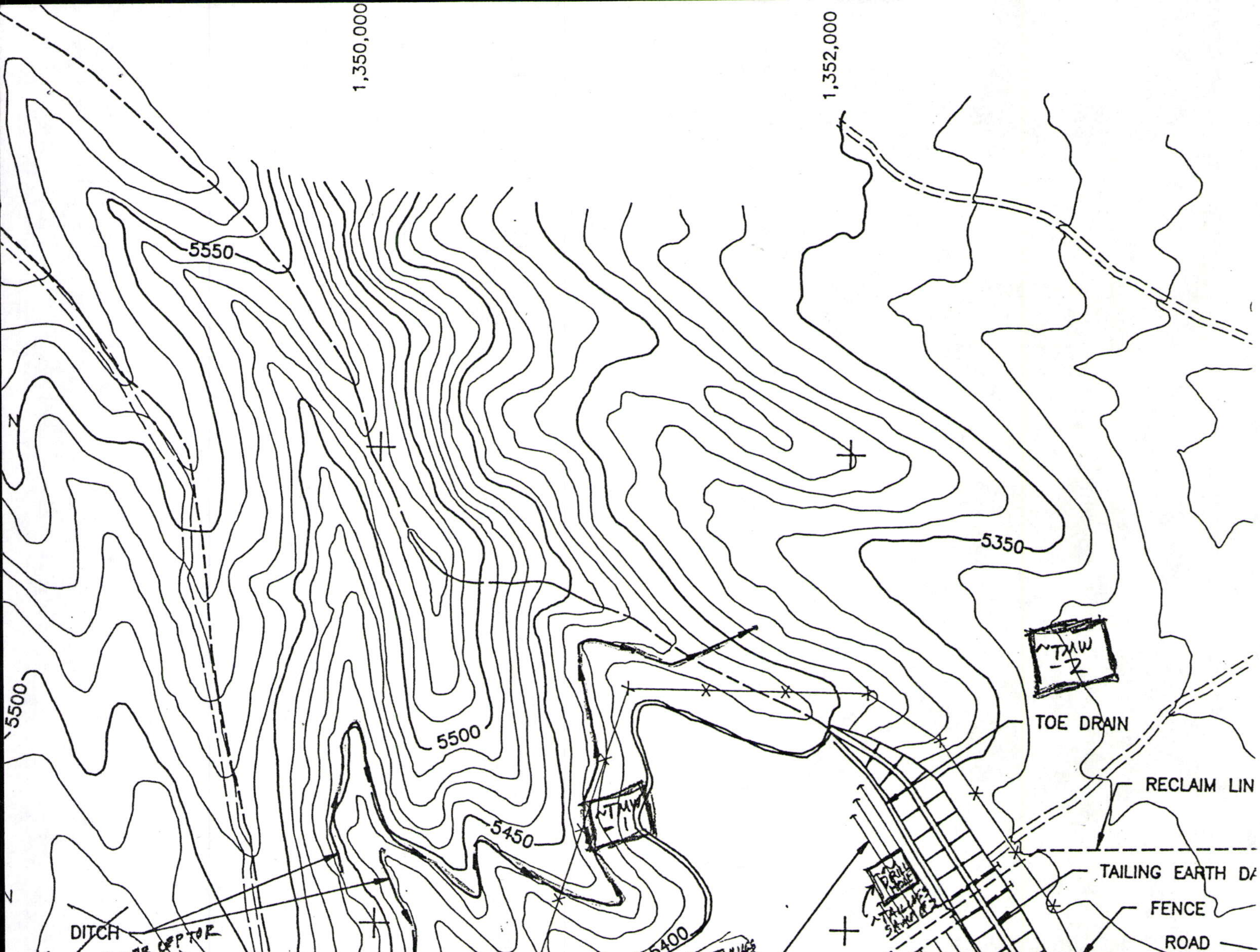
HAMBLIN VALLEY
Hamblin Valley
3rd Guide Meridian West
8176
6475
6525
LUND
D E S E R
E S C A L A N T E
ZANE
BERYL
5147
UNION PACIFIC
Modena City Reservoir
7820
MODENA
6540
UVADA
Tonapah, 228 Mi.
7010
BERYL JUNCTION
56
ESCALANTE MINE
NEWCASTLE
5314
Dick Palmer Wash
TABLE BUTTE
5878
Iron Springs Creek
THREE PEAKS
Rock Spring
ANTELOPE PEAK
7260
ANTELOPE RANGE
7th Standard Parallel
Neck of the Desert
Big Hollow Wash
SILVER PEAK
7273
Joel Spring Cyn
RED HILLS
IRON MTN
7501
SWETT HILLS
Leach Canyon
Little Dry Wash
Shoal Creek
18
ENTERPRISE
DEATH VALLEY PARTY MON
HOLT HISTORIC SITE
KANE POINT
7380
OLD IRONTOWN
Kane Spring
Pinto Creek
FLAT TOP MTN
7229
STODDARD MTN
8378
HARMONY MOUNTAINS
Richie Flat
IRON CO
WASHINGTON CO
ESCALA INTERPRETIV
HAMBLIN HIST SITE
Meadow
Valley Meridian
7260
PINTO
Enterprise Res
7312
HONEY COMB ROCKS
ENTERPRISE RES
FLAT TOP MTN
7314
Ox Valley
BIG MOUNTAIN
7233
Mountain Meadow
DIXIE NATIONAL FOREST
FT HARMONY
BALD HILL
5308
NEW HARMONY
Red Butte
MAPLE RIDGE
Racer Cyn
HARRISON PEAK
Pine Valley
MOUNTAIN MEADOW MASSACRE
7862
9120
TIMBER MOUNTAIN
Ash Cr
BULL VALLEY MTNS
THE PINNACLES
Moody
6539
Creek
McFARLANE MTN
PINE VALLEY CHURCH
CENTRAL
Grass Valley
MT BALDY
Ash Creek Reservoir
Slaughter Creek
Black Cyn
COVE MTN
BULL MTN
Cove Wash
Magotsa
PINE VALLEY
PINE RIDGE
9520
PINE VALLEY MOUNTAINS
GOLDSTRIKE
5280
W.M.A.
7040
Pine Valley
Leap
JACKSON PEAK
Miners
Tobin Bench
Tobin W
Baker Dam Res
Big Cove
10035
East Fork
Manganese Wash
Canyon
VEYO
PINT
MOTOQUA
GUNLOCK
12
Upper Sand Cove Res
Santa Clara
WILDLIFE MGMT AREA
OAK GROVE
CEDAR RIDGE
Leeds Cr
WILDLIFE MANAGEMENT AREA
GUNLOCK LAKE STATE PARK
EXTINCT VOLCANO
6590
Parallel
Lower Sand Cove Res
Paheoons Sprs Wash
RED MOUNTAINS
SNOW CANYON STATE PARK
Cedar Bench
LAVA RIDGE
SILVER REEF
LEEDS
TOQUE
5460
Gulch
Mill
Cottonwood Canyon
Yant Flat
RED CLIFFS
QUAIL CREEK STATE PARK
LaVERKIN
BEAVE
5765
Santa Clara Bench
Big Sand
Black
3229
HURRICANE


1,350,000
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5550
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~TMW -2
TOE DRAIN
RECLAIM LIN
TAILING EARTH DA
FENCE
ROAD
~TMW -1
5450
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~~DITCH~~
BASIN INTERCEPTOR TRENCH ?
~TAILINGS SAMPLE 3
RECOVERY DRAIN SYSTEM
~ TAILINGS SAMPLE 1
~TMW -3
LIMIT OF DRAINAGE AREA (270 ± Ac)
5450
5500

Introduction

Hecla Mining Company and its predecessor, Ranchers's Exploration and Development Company mined and permitted the Escalante Mine. The mine was permitted and bonded in September of 1980. The surety is $181,500. Unfortunately, the original MRP addressed reclamation of everything at the site except for the tailings pond. The tailings pond reclamation plan is currently under review. Questions regarding the reclamation of the pond are posing some major hurdles for the company.

Questions dealing with ground water impacts, adequate reclamation, and permanent site stabilization have not yet been resolved. The Division, Bureau of Water Quality, Bureau of Air Quality, the Division of Wildlife Resources and the BLM are all involved in reviewing this plan.

The operation became inactive last summer of 1990 and has been under reclamation for two years. Most of the site has been reclaimed except for the tailing facility, offices and warehouse. Our tour will focus specifically on the tailings pond.

Land Use

The tailings impoundment is located on U. S. Bureau of Land Management (BLM) land. Adjacent parcels of land are owned by the BLM, as well as Hecla. The pre-operational use of this land included occasional grazing, mining and exploration activities, and wildlife habitat. The probable land uses during the post Escalante mining stage will be occasional grazing, minerals exploration and mining activities, and wildlife habitat.

Tailing Impoundment Reclamation

The reclamation objectives for the 65-acre (58-acres surface area before reclamation) are three-fold. A capillary clay barrier is proposed to impede the downward migration of moisture. The clay barrier will also minimize any upward translocation of available salts or metals. The last objective would be to establish a self-sustaining vegetative cover to protect against wind and water erosion, as well as forage for animals.

Generally, the reclamation prescription proposed to meet these objectives consists of a 6-inch clay barrier installation, 14 inches of subsoil placement 4 inches of topsoil placement, application of hay, seedbed preparation, seeding, vegetation establishment, and maintenance. The total depth of material placed on the tailings will be two feet.

The 14-inch subsoil layer is intended to duplicate the subsoil layers in adjacent areas (Checkett soils). This less clayey layer is intended to provide a rooting medium, as well as a medium for supplying vegetation with moisture. As an additional measure to assist vegetation establishment, hay will be added to the subsoil and to the topsoil layer above the subsoil. The BLM has observed these types of soil amendments in the past and believes that hay tilled into the subsoil and topsoil layers at a rate of two to three thousand pounds per acres is adequate to assure vegetation establishment.

The four inches of topsoil will be placed on top of the subsoil. Since the topsoil will come from the revegetated stockpile established ten years ago, some established vegetation such as Russian wildrye and crested wheatgrass are expected to persist.

After applying hay to the top two layers, the topsoil will be drill seeded. In order to further remove the potential of downward water migration and contaminant uptake from the tailings area, we propose to seed the area with shallow-rooted grasses. The shallow-rooted grasses will be able to take up moisture earlier in the year when the shrubs are still dormant. This should help minimize the amount of water that migrates to the top of the compacted clay layer.

Expectations are that shallow-rooted grasses will establish and hopefully dominate. Because of the difficulty of rangeland seeding in Checkett soils, follow-up grass seeding may be needed. A diversity of grasses should establish roots down to the top of the compacted clay layer.

Because of the sodic nature of the tailings two feet below the surface, we must accept that ultimately a physical and/or chemical climax community of grasses may dominate. Any pioneering deep-rooting shrub or forb species that takes root may find it difficult to establish on this site.

Shrub species are looked at as being detrimental to the clay cap, so will be left out of the seed mixture.

Problems Associated With the Site

Recently the operator was cited by the Bureau of Water Pollution Control for blowing dust. This was in April of 91. The tailings desiccate very rapidly, and with the drought and high winds last month, was kicking up some severe dust storms. The locals complained and the local press wrote of clouds of cyanide laden dust. The tailings were treated on April 29th with $50,000 worth of a soil binder (polyacrylamide).

During the spring waterfowl migration of 1988, the operation's tailings pond may have killed several hundred avocets and other waterfowl, which mistakenly mistook the pond's surface as an overnight refuge. The free cyanide levels in the pond at that time where @70 ppm. One of the major problems with mine ponds containing cyanide is with waterfowl mortality. Unfortunately this particular site is below a major flight of migrating waterfowl.

The operator is currently awaiting the go-ahead from various federal and state agencies to start reclamation of the tailing pond. One major hurdle is BWPC's requirement that the operator obtain a groundwater discharge permit for the site.

Other

Please find attached a section taken out of an article discussing tailings ponds. The article specifically addresses the Escalante Mine's tailings facility, and provides some tailings analysis, which should provide a better idea of the problems of decommissioning and reclaiming this particular site.

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Reclamation research has not yet satisfactorily dealt with the problem of root penetration into tailings or other potentially hazardous media. It has been demonstrated that many plant species can accumulate potentially toxic (to animals and humans) concentrations of trace metals, with no apparent harmful effects to the plant. The potential, for physical or biological migration of hazardous substances through soil covers from waste materials to reclaimed surfaces and to the environment, does exist. This potential cannot be generalized, and must be evaluated on a case-by-case basis. In cases of significant concern, increased cover thickness and/or the use of impermeable barriers can be warranted. (Stanton)

TAILINGS PONDS

Mine tailings ponds/impoundments are generally constructed to contain the final process wastes from an ore milling operation. In the past their construction was haphazard, mostly performed to keep the wastes out of the way of the mining and/or milling operation generating the wastes. Today their construction has developed more of an orientation toward avoiding environmental contamination. This orientation is becoming more and more of a focus as environmental regulations are tightened up. Operations in the State of Utah utilizing tailings facilities are processing uranium ore, copper ore, and silver and gold ore.

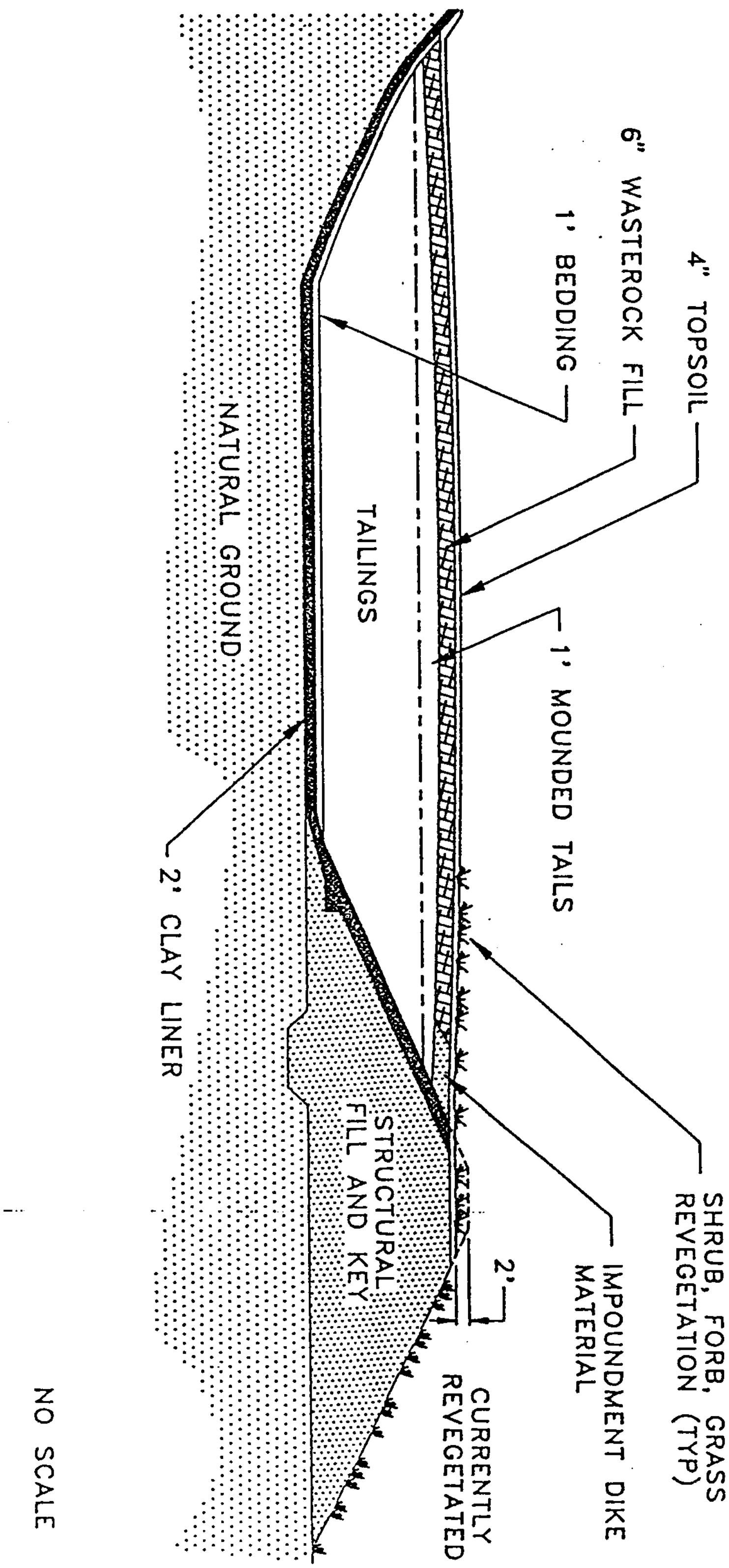
Tailings facilities are intended to contain all the concentrated wastes, unwanted by the generator. Tailings by their very nature are more hazardous to the environment, then the original ore material, because the increased surface area of the crushed and ground tailings provides for higher concentrations of heavy metals and acid forming materials. Also, other hazardous chemical substances used in the milling process end up in the tailings pond. Hazardous constituents within the tailings are more readily mobilized in an aqueous environment.

Chemical and physical processes that transport tailings include: leaching, capillary rise, seepage, diffusion, water table formation, wind erosion, and water erosion. These transport processes are predominantly dependent on water. Water control is the single most important element in tailings containment and reclamation. The intensity of most of these processes is dependent on climate. Capillary rise and erosion are generally dominant processes of tailings transport in arid areas while leaching, water-table formation, and seepage are often the dominant forms of tailings transport in humid areas (Barth, 1986). An understanding of the practical implications of these processes is essential for tailings decommissioning and reclamation.

Basic Construction and operation

A tailings pond will typically consist of an engineered dam or dike behind which will be contained mine processing wastes or tailings. Typically these impoundments will be quite large to accommodate large volumes of mining wastes over many years of operation the ore processing facility. In Utah the largest tailings impoundment, belonging to Kennecott Minerals, is 5,000 acres in size. Other active tailings impoundments in the state range from 60 to 120 acres in size. These ponds will generally have a compacted clay liner ranging from 2 to 3 feet in thickness and generally have conductivity ratings of 1×10^{-7} cm/sec (note: Kennecott's ponds where never lined having originated some 30 years ago).

Figure 2 shows a typical cross-section of a tailings facility. The figure also shows a reclamation cover for the pond. Depending upon the nature of the tailings the top cover will consist of a clay or capillary barrier over which will be spread 1 foot to 4 feet of topsoil material or plant growth medium. The cover becomes extremely important in the ultimate containment of the tailings and will be further discussed in the reclamation section of this paper.



EAST/WEST SECTION
ESCALANTE SILVER MINE TAILINGS
CLOSURE PLAN

taken form (Hecla, 1989)

Hazards

In the processing of silver and gold, cyanide complexes and heavy metals can be a hazard. In the processing of copper ore, heavy metals are the main constituents of concern. In the processing of uranium ore, radio-nuclides and radium found in this material is of concern. The methods for containing these wastes are for the most part the same, however depending level of toxicity of the waste one approach may be several magnitudes greater than another.

Leaching moves soluble tailings constituents downward with the leachate eventually exiting the tailings impoundment as seepage into the vadose zone and threatening the groundwater. Leachate seepage can transport substantial volumes of tailings contaminated solutions to areas beyond the perimeter of the tailings impoundment. Seepage probably represents the most important and damaging aspect of tailings transport.

During active use of tailings impoundments, seepage can usually be controlled by a variety of means, including interceptor soil-bentonite slurry trenches, pumpback systems, dewatering prior to deposition, and the use of various types of liners to seal the base of the impoundment. Following closure, seepage should decrease substantially because water is no longer being added to the impoundment by ore processing, but seepage will not cease altogether, because precipitation and perhaps off-site drainage add water to the impoundment. As a result, the leaching and seepage process usually continues at a decreased rate, following closure (Barth, 1986).

Local examples

As an example of the types of heavy metal problems and other problems associated with a tailings facility, the following example is provided. The Escalante Silver Mine located in Iron County will soon be reclaiming the 60 acre tailings pond associated with the site. The pond has been part of a cyanide process circuit and contains several undesirable materials. Table 2 shows a comparison between desirable topsoil material and the tailings material. Some of the metals such as barium, copper, lead, manganese, and zinc should be of particular note. Another problem with this tailings material is the particularly high levels of sodium which range from 316 ppm to 994 ppm, also SAR values range from 35.4 to 113.2 (see table 3). The Sodium Adsorption Ration (SAR) indicates the ratio of soluble sodium to soluble calcium plus magnesium in soils. An SAR value of 10 or more indicates a sodic (sodium affected) soil (USDA, 1979). Such levels make the material deleterious to plant growth.

The high levels of heavy metals in the Escalante Silver Mine's tailing, suggest the possibility for groundwater or surface water problems, if leachates produced in the pond escape beyond the pond's boundaries. This would be especially true if the pH levels in the pond were to drop below their present levels of 9.5 to 9.8. Concentrations of heavy metals residing in the pond are loosely complexed and would become easily mobilized in a more acid environment. After the leaching solutions have been turned off, the leached material may return to a more neutral pH. This will be especially true if the material is flushed with a fresh water solution before abandonment.

Excess sodium, in the soil profile, affects plant growth by causing a deterioration or dispersion of the soil structure. This deterioration causes restricted water availability to plants. It also restricts aeration, root elongation and seedling development. Sodium soils also affect plant growth by inhibiting nutritional access of calcium and magnesium (Williams and Schuman, 1987).

Total Metals Analysis Hecla Tailings

Table 2

Analyses	Topsoil	Waste Material
Total Cyanide	<0.2 mg/mg	116.9 mg/kg
Total Aluminum	18,724 mg/kg	15,148 mg/kg
Total Arsenic	<5.00 mg/kg	288 mg/kg
Total Barium	224 mg/kg	6,907 mg/kg
Total Cadmium	<0.5 mg/kg	40.7 mg/kg
Total Chromium	15.2 mg/kg	17.2 mg/kg
Total Copper	<1.00 mg/kg	623 mg/kg
Total Iron	16,418 mg/kg	12,273 mg/kg
Total lead	<5.00 mg/kg	6,425 mg/kg
Total Manganese	634 mg/kg	1,466 mg/kg
Total Mercury	0.06 mg/kg	0.39 mg/kg
Total Molybdenum	<1.00 mg/kg	<1.00 mg/kg
Total Nickel	12.mg/kg	560 mg/kg
Total Silver	<1.00 mg/kg	61.9 mg/kg
Total titanium	1,650 mg/kg	759 mg/kg
Total Zinc	76.1 mg/kg	8,132 mg/kg
Total Solids	97.7 %	88.9 %
Extractable Selenium by AB-DTPA	0.09 mg/kg	<0.05 mg/kg

Table 3

HECLA TAILINGS ANALYSIS

Analysis	Sample Number		
	1	2	3
Texture Class	Si loam	Silt	Silt
Sand %	14	10	10
Silt %	78	84	82
Clay %	8	6	8
EC (mmhos/cm)	1.6	3.7	3.7
Ca ppm	1425	1400	1412
Mg ppm	20	17	20
Na ppm	316	994	859
Sodium Absorption Ratio (SAR)	35.4	111.8	113.2
Acid-Base Potential	162	151	157
Pyritic Sulfur %	.04	.02	.01
$CaCO_3$ Equiv. %	163	151	157

NOTE: Sample collected June of 1989

Reclamation and Decommissioning of Ponds

When reclaiming a tailings facility it is necessary to isolate the tailings as much as physically possible from the surrounding environment. This would entail providing a sufficient cap over the tailings facility such that moisture is prevented from entering the tailing, and such that the tailings are prevented from escaping to into the air or surface water via wind or rain erosion. Excess water moisture would allow for the build up of potentially dangerous leachates over time. A sufficient plant growth medium is an important element in providing an adequate and stable soil cover. The plants will help keep the cap in place as well as help in transpiring moisture away from the tailing. The soil depth above the deleterious material must be adequate to allow healthy plant growth.

In designing an adequate tailings cover it is necessary to incorporate a capillary barrier or clay cap into the design. The capillary barrier would be used to prevent capillary rise or wicking of contaminants above the tailings surface, and thereby affecting plant growth. However, it would not prevent water entering the soil profile from eventually infiltrating into the tailing.

A clay cap compacted to a minimum conductivity of 1×10^{-6} cm/sec, would act to prevent water infiltration into the tailings and vice versa. Two problems may arise in the use of a clay cap: 1. given the nature of the tailings material the clay may be difficult to compact; and 2. a clay cap will act to prevent any natural neutralization of the tailings material over time, effectively encapsulating the tailing.

Because of the added expense of borrowing the clay material, an operator may choose to elect to use only a capillary barrier. The capillary barrier will work if the tailings facility is located in an arid climate and the amount of topsoil to be applied, will be sufficient to keep unacceptable amounts of moisture from reaching the tailing. It is possible to eliminate water infiltration into the tailings material with an adequate soil cover, as runoff, evapotranspiration, and capillary rise will remove water from the pond surface in a greater quantity than what is deposited via precipitation. This concept is based on the following equation:

$$C = P(1 - R) - S - E$$

where C = total percolation in the top layer of soil, in inches or mm
P = annual precipitation, in inches or mm
R = the runoff coefficient
E = annual evapotranspiration, in inches or mm
S = soil storage, in inches or mm per foot of meter (in/ft)

(Ghosh, 1990)

A build up of leachate after abandonment of the site is not desirable, and any cover design for the pond must take this into consideration.

It is possible that the tailings themselves could be used as the restrictive barrier. tailings material of a highly dispersed nature due to sodium, have been used in the past for liners and caps for impoundments. Another advantage to their use is the fact that they don't require compaction (Barth, 1986).

Nawrot(1981) found that in some cases, formation of a water table may be desirable. When tailings contains pyrites, oxidation and subsequent acid formation and metal transport are of concern. The creation of anaerobic conditions, via submersion, may offer a means of restricting acid formation. The above author found that a high water table limited the depth of acidification of a pyritic coal slurry impoundment, and that the occurrence and maintenance of a high water table appeared important in the revegetation of coal slurry waste.

One of the most difficult aspects of reclaiming a tailings pond is the removal of water. tailings are commonly deposited as a slurry containing from 45 to 80 percent water. Following deposition, a large portion of the water is removed by sedimentation and decantation, but additional water must be removed prior to reclamation. Most dewatering operations rely on evaporation. In some situations, evaporation is slow and means to increase the surface area, such as trenching, may be effective in dewatering (Barth, 1986).

Some materials because of high clay content, are extremely difficult to dewater, and pose a real barrier to successful reclamation and containment of harmful constituents. They often require state-of-the-art applications of expensive cover material to stabilize them.

This page is a reference page used to track documents internally for the Division of Oil, Gas and Mining

Mine Permit Number M0210004 Mine Name Escalante Silver
Operator Hecla Mining Co. Date May 1, 1991
TO ______ FROM ______

__CONFIDENTIAL __BOND CLOSURE __LARGE MAPS X EXPANDABLE
__MULTIPUL DOCUMENT TRACKING SHEET __NEW APPROVED NOI
__AMENDMENT _OTHER ______

Description YEAR-Record Number

__NOI X Incoming __Outgoing __Internal __Superceded

Brief for DOGM 1991 Spring
Jamboree

__NOI __Incoming __Outgoing __Internal __Superceded

__NOI __Incoming __Outgoing __Internal __Superceded

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__TEXT/ 81/2 X 11 MAP PAGES __11 X 17 MAPS __LARGE MAP

COMMENTS: ______

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